

REMARKS

Upon entry of the Amendment, which is respectfully requested, claims 1, 2, 5 and 17 will be pending. Claim 1 is amended to incorporate the subject matters of claim 7, which have been canceled. Claim 2 has been amended to be consistent with claim 1. New claim 17 has been added. Support for new claim 17 may be found, for example, in the Examples of the present application. No new matter is added.

Entry of the above amendments is respectfully requested.

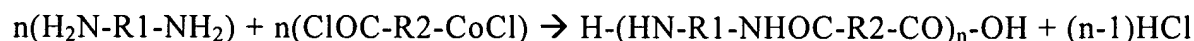
The Present Invention

Claim 1 is directed to a process for producing a composite semipermeable membrane which comprises forming on a surface of a porous supporting film a thin film comprising a polyamide resin obtained by reacting an aqueous solution comprising a polyfunctional amine ingredient in the presence of at least an alkali metal hydroxide and an organic acid with a polyfunctional acid ingredient, wherein the polyfunctional amine ingredient is aromatic or aliphatic, wherein the ratio of the normality of the alkali metal hydroxide to that of the organic acid to be mixed therewith (alkali metal hydroxide/organic acid) is from 1.2/1 to 0.9/1, and wherein the thin film is heated to 100°C or higher, wherein the organic acid contains a sulfo group, and wherein the aqueous solution has a pH of 5-11.

It is respectfully submitted that the present invention is patentable over the cited references. In particular, none of the references disclose such conditions, and even if the references were to be combined, one of ordinary skill in the art would not arrive at the present invention.

In the present invention, the aqueous solution having a pH of 5-11 is critical for the following reasons.

A polyamide of a skin layer is obtained by interfacial polymerization of amine with acid halide, for example, acid chloride, as follows.



The pH being less than 5 is not preferable because as shown above, HCl is produced as by-product, in addition to the polyamide. In the case where the pH of the aqueous solution is acidic, since it is not possible to remove this by-product, the reaction is inhibited. As a result, the polymerization degree (degree of crosslinking) does not rise, and the produced membrane has molecular defects, thereby lowering the IPA rejection against uncharged substances.

In addition, the pH being more than 11 is not preferable because the reaction is promoted in view of the polymerization reaction of the polyamide. Since hydrolysis of acid chloride is accelerated, the concentration of acid chloride exists adjacent to the interface and contributes to the interfacial polymerization being lowered. As a result, a polyamide of the skin layer is not well formed, which thereby lowers both the IPA rejection and the permeation flux.

For at least the above reasons, it is respectfully submitted that the present invention is patentable over the cited references for the reasons discussed above.

Additionally, the present invention is patentable for the following reasons.

Claim Rejections under 35 U.S.C. § 103

Referring to pages 2-3 of the Office Action, claims 1, 2, 5 and 7 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Agarwal (U.S. Patent No. 6,833,073; Its Pre-Grant Publication: U.S. Application Publication No. 2003/0066796 has a 102(a) date) or JP 2000-117076 and further in view of Hirose or Tomaschke as applied below in paragraphs 2 and 3.

The Examiner cites Agarwal as teaching a process for making a semipermeable membrane over polysulfone porous film by interfacial polymerization of a polyfunctional amine such as piperazine or polyphenylene diamine in an aqueous solution containing propionic acid (an organic acid) and sodium hydroxide, with a polyfunctional acid halide solution in an organic phase (col. 3, lines 7-49). The Examiner indicates that since the present specification does not provide any criticality for a sulfo group as compared to a carboxyl group, the present invention is unpatentable in view of Agarwal disclosing propionic acid as an organic acid.

Applicants traverse and respectfully request the Examiner to reconsider in view of the following remarks.

Agarwal discloses the use of propionic acid as an organic acid having a carboxyl group. However, a skilled artisan would not be motivated to use propionic acid in the present invention for the following reasons.

Propionic acid has a special nature compared to other carboxylic acid such as acetic acid. Specifically, propionic acid is precipitated as oily matter when salting-out is performed.

Against this background, consider the use of propionic acid in the process of the present invention, specifically, if propionic acid and alkali metal hydroxide are added into the amine aqueous solution. In such case, the drying step includes heating to more than 100°C followed by an interfacial polymerization step which results in the increase of the concentrations of both the propionic acid and the alkali metal hydroxide. However, since the propionic acid and the alkali metal hydroxide are a combination of a weak acid and a strong base and the hydration force of the alkali metal hydroxide is stronger than that of the propionic acid, propionic acid is salted-out, thereby precipitating as oily matter. As a result, the pH becomes alkaline, the reaction is unable to proceed, and the formation of the skin layer stops. (See the above-mentioned reaction formula in the “Present Invention” section).

In contrast, claim 1 requires that the organic acid contains a sulfo group. Various sulfonic acids are strong acids, and therefore, their hydration forces are in the same range as the hydration forces of alkali metal hydroxides. Accordingly, the organic acid is not precipitated as oily matter and the bias of pH does not occur, and thus, interfacial polymerization can proceed through to completion. As a result, a skin layer having high performance can be produced in the present invention.

In this regard, it is submitted that Agarwal does not disclose the use of an organic acid containing a sulfo group, and the Examiner has failed to provide any reason as to why one of ordinary skill in the art would use such an organic acid.

Furthermore, JP 2000-117076 does not render the present invention obvious. As shown in the Table on page 17 of the specification, the Comparative Examples, as a result of having an aqueous solution which does not comprise both alkali metal hydroxide and sulfonic acid, have poor IPA rejection and permeation flux as compared to the present Examples. JP 2000-117076, like the present Comparative Examples, does not disclose an aqueous solution comprising alkali metal hydroxide and sulfonic acid. Therefore, one of ordinary skill in the art would expect JP 2000-117076 to produce a membrane having poor IPA rejection and permeation flux as compared to the present invention.

Moreover, there is no motivation to combine the references to arrive at the claimed invention. Even if there were some motivation, it is submitted that neither Hirose nor Tomaschke make up for the deficiencies of Agarwal or JP 2000-117076. *See arguments below.*

For at least the above reasons, Applicants respectfully request reconsideration and withdrawal of the § 103(a) rejection of claims 1, 2 and 5 based on Agarwal or JP 2000-117076, in view of Hirose or Tomaschke.

Claim Rejections under 35 U.S.C. § 103

Referring to page 4 of the Office Action, claims 1, 2, 5 and 7 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over WO 99/01208 (U.S. equivalent to Hirose, U.S. Patent No. 6,723,422 is used for the rejection).

The Examiner cites Hirose as teaching a method of making a polyamide membrane over a porous support film by interfacial polymerization of a polyfunctional amine and a

polyfunctional acid chloride in the presence of an organic acid and sodium hydroxide that renders obvious the present invention.

Applicants traverse and respectfully request the Examiner to reconsider in view of the following remarks.

The present invention relates to a process in which the thin film is formed by bringing an aqueous solution prepared by mixing at least the polyfunctional amine ingredient, the alkali metal hydroxide, the organic acid, and water into contact with an organic solution containing the polyfunctional acid ingredient to cause interfacial polymerization.

In contrast, the alkali metal hydroxide (sodium hydroxide) of Hirose is allegedly used to adjust the pH. However, there is only one disclosure regarding pH adjustment and that consists of contacting the aqueous solution with sodium hydroxide, that is separately provided, after the interfacial polymerization. Therefore, this process is clearly different from the process of the present invention. Accordingly, it is submitted that the present invention is not anticipated or rendered obvious in view of Hirose.

For at least the above reasons, Applicants respectfully request reconsideration and withdrawal of the § 103(a) rejection of claims 1, 2 and 5 based on Hirose.

Claim Rejections under 35 U.S.C. § 102 and/or § 103

Referring to page 6 of the Office Action, claims 1, 2, 5 and 7 are rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as allegedly being obvious over Tomaschke (U.S. Patent No. 6,464,873).

The Examiner cites Tomaschke as teaching a method of making a polyamide membrane by interfacial polymerization (see example 1) which anticipates and/or renders obvious the present claims. In particular, the Examiner states that Tomaschke discloses a polyamine (bipiperidine) and a polyacid chloride (trimesoyl chloride) in the presence of camphor sulfonic acid (formed by the hydrolysis of TEACSA in water) and sodium hydroxide on polysulfone porous membrane.

Applicants traverse and respectfully request the Examiner to reconsider in view of the following remarks.

Claim 1 requires that the polyfunctional amine ingredient is aromatic or aliphatic. Tomaschke discloses bipiperidine as the amine ingredient; however, it is not within the scope of claim 1. Specifically, in view of pH of the aqueous solution, the reaction property of bipiperidine is different from that of the presently claimed aromatic or aliphatic amine.

Furthermore, Tomaschke discloses that “the choice of pH depends on the base strength of the particular bipiperidine reactant employed” (see col. 8, lines 40 to 41) and that the aqueous solution containing bipiperidine reactant is generally adjusted to pH of about 10 to about 14, preferably about 11 to about 13 (see col. 8, lines 28 to 39). Additionally, in “Membrane Preparation Example 1”, the pH of the solution is adjusted to 12.75.

Thus, it is respectfully submitted that Tomaschke is different from the present invention, and that Tomaschke does not anticipate nor render obvious the present invention according to claim 1.

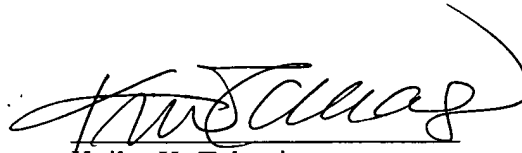
For at least the above reasons, Applicants respectfully request reconsideration and withdrawal of the § 103(a) rejection of claims 1, 2 and 5 based on Tomaschke.

Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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